A

POPULAR EXPOSITION

OF

THE MODERN DOCTRINE OF TUBERCULOSIS,

WITH APPLICATIONS,

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PREFATORY NOTE.

This is practically a synopsis of the larger work "On the Prevention of Tuberculosis" issued some months ago, and distributed to all the medical practitioners of Glasgow and many of the citizens. It is intended for the use of persons who may have the opportunity of teaching others, and may desire to have a full and intelligent view of the modern doctrine of Tuberculosis. This will not merely make them better teachers, but will enable each, in his or her own sphere, to think out in detail the various applications of the doctrine, of which this pamphlet suggests but a few.

J. B. R.

THE MODERN DOCTRINE OF TUBERCULOSIS.

TUBERCULOSIS IN GENERAL.

The word tuberculosis, or tuberculous disease, is associated in the popular mind almost exclusively with Phthisis or Consumption of the Lungs. This is by far the most frequent and most deadly form of tuberculosis; but every organ and every tissue of the body may be the seat of tuberculous disease. Hydrocephalus is tubercle in the membranes of the brain; Tabes Mesenterica is tubercle in the lymphatic glands of the abdomen; Scrofula, in the popular sense, is tubercle in the superficial lymphatic glands, most familiar in the neck; Lupus is tubercle in the skin; there is tubercle of the joints and of the bones, giving rise to suppurations in all sorts of places, and occasioning surgical operations almost as various in their nature as in their locality.

What is Tuberculosis?

Tuberculosis is a disease, not only of man, but of the lower animals. No warm-blooded animal is insusceptible when artificially tested, but it occurs naturally with great frequency in those which are domesticated or confined, as the cow, the pig, the rabbit, in fowls, in monkeys, &c.

The only cause of tuberculosis is the tubercle-bacillus. Without the bacillus there can be no tuberculous disease. Therefore, to prevent tuberculosis, we must stamp out the

bacillus. From our point of view, tuberculosis is a disease. From the point of view of the bacillus, it is a natural life-process. The bacillus has a plan of life laid down for it, providing, as usual, for the maintenance of the individual and the propagation of its kind. Clearly, it is necessary that we should understand this plan before we can hope to disconcert it. The prevention of tuberculosis rests upon the biology of the bacillus.

The Biology of the Bacillus.

The bacillus is not inherited. As regards Pulmonary Consumption, this statement may be taken as absolutely true. The bacillus *may* pass from a tuberculous parent into the body of the fœtus, and be born with it; and thus the offspring may carry into independent life a tuberculous process, but this fact has merely an academic interest. Tuberculosis has been actually seen in the fœtus with just sufficient frequency and certainty to prove that the inheritance of the bacillus is not impossible. For all practical purposes, the hygienic administrator is bound to regard *every* case of tuberculosis as caused by infection which has taken place so to speak in the open—within the sphere of his control.

The tubercle-bacillus not being inherited, but passing into the body from the outside, how does it get there? Under what conditions does it exist there? Under what conditions does it pass from the outside to the inside of the body? Under what conditions does it live and propagate there? It is impossible to demarcate the answers to these questions as clearly as the questions themselves. In nature the facts are interlaced, but, at any rate, the questions so stated will promote clear thinking.

The bacillus multiplies by subdivision and by the production of spores. As compared with other disease-producing organisms, it grows very slowly even under the most favourable circumstances. To be effective, therefore,

these circumstances must be maintained for weeks continuously. At a temperature of 86° F. growth is much enfeebled, and it entirely ceases below 82°·4 F. It cannot grow at a temperature above 107°·6 F. It flourishes at the natural deep temperature of the human body, viz., 99° to 100° F. Moisture is absolutely essential to growth, with a limited supply of air and an absence of light. Obviously, we have here an aggregate of conditions which, in this country at any rate, can only be found in nature *inside the animal body*. The tubercle-bacillus cannot multiply outside the animal body; it can merely live, and live only under certain conditions, and under any conditions only for a limited time.

When the bacillus obtains access to the body of a warm-blooded animal, which it almost solely does by the great main entrance, the mouth, passing thence into one or other of the diverging channels, the windpipe and the gullet, it is not yet in a physiological sense inside the body. It must break through the mucous surface of these passages. This is a most important stage in the career of the bacillus from a preventive aspect, which must be dealt with at large further on. Meanwhile, let us assume that the bacillus has broken through, still it has enemies in the tissues and fluids of the body. These also have a supreme interest for us, but these also we shall meanwhile pass by. If every circumstance has proved favourable, the bacillus proceeds *slowly* to multiply, and in doing so to invade and break down the natural tissue around. It may be borne along the stream of lymph or blood, or be carried by wandering cells to other parts of the body. However it may be effected, in all movement the bacillus is passive. Wherever it establishes tuberculosis, the process has products—irritated and disorganised tissue, pus, &c. These products have the relation of foreign bodies to the healthy tissues, and have therefore an eccentric or centrifugal bias. They may, however, be imprisoned and retained, sometimes changed in nature. If the process lies on the line of the great channels by which the

bacillus gained entrance, then it has an equally patent exit—in consumption, by the expectoration, or by the fæces, if the expectoration is swallowed. If the process is in the bowel or the kidney, or any organ having a natural exit for its products, then the morbid matter passes out thus. If the process is in bone or lymphatic glands, or in any locality from which the nearest way outwards is through the skin, then we may have abscesses and a discharge of matter therefrom. To us this is a feature of disease. To the bacillus it is a phase in the cycle of its life. These discharges carry out bacilli and their spores; and these bacilli and their spores maintain the stock of infecting material outside the animal body upon which the continuance of the tubercle-bacillus as an individual and of tuberculosis as a disease depends.

What are the conditions which favour the continued vitality of the bacillus, and preserve the potential activity of its spores outside the animal body?[1] Although the bacillus will not grow, excepting under the conditions of heat and moisture described, it is not killed either by natural cold or heat, or by drying. It is, indeed, one of the hardiest of all disease-producing germs. Freezing has no effect. It resists putrefaction for weeks, and endures in the dry state for months. The greater stability in resisting natural agents and conditions to which other germs speedily succumb is, no doubt, compensatory for the characteristics of parasitism and slow growth. If the bacillus, being unable to grow anywhere but inside a warm-blooded animal, were also unable to survive outside, it would be exterminated. On the other hand, from the animal's point of view, the extremely sluggish growth of the bacillus, and its inability to grow outside, in a measure countervails its tenacity of life, otherwise the animal would be exterminated. Still, in spite of this tenacity of life, the

[1] It is impossible to speak separately of the bacilli and their spores. Observations and experiments really refer to the loss or the retention of the property of infectivity.

combination of hostile conditions outside the animal body ultimately proves fatal to the bacillus. Direct sunlight will kill the bacillus in a few minutes, and ordinary daylight in a few days, whether it be exposed naked in cultures, or in sputum or in dust, and in each case free flowing air makes the light more active. The converse of these conditions—darkness and stagnant air—favour the bacillus.

TUBERCULOSIS IN MAN.

Hitherto we have dealt with tuberculosis in its general sense, without reference to the species of the animal in which it is found, or the locality of the body where it is seated. In harmony with the general law of life, the bacillus is varied by the soil in which it grows, and the disease to which it gives rise derives characteristics both as to locality and nature from the physiological idiosyncrasies of the species. For these reasons, and since it is in man that we are *directly* interested, we shall now consider specially *tuberculosis in man.*

Putting aside, as of no practical importance, the very rare case of inheritance of the bacillus, man, like other animals, suffers from tuberculosis only when he receives the bacillus from without. Putting also aside, as of no great practical importance from a sanitary aspect, cases which arise from direct inoculation by wounds or through scratches and other ruptures of the integrity of the skin, it may be said that the bacillus always enters by the mouth, that it is either inhaled or swallowed, that it is conveyed either in the air or the food, that it enters either by the lungs or the alimentary canal, or stops short in the structures in and adjacent to the mouth.

Every bacillus and spore thus inhaled or swallowed must have been produced in an animal, not merely derived from or descended from a bacillus or spore produced in an animal, but must itself have passed out from a diseased

animal or been included in the flesh derived from a diseased animal.

Tuberculosis in man is, therefore, caused by infection either (1) through the excretions or discharges from infected animals, including man himself; or (2) the milk of infected animals, including his own species; or (3) the flesh of infected animals.

Infection by Sputum and other Discharges.

There is a remarkable consensus of opinion that persons suffering from Phthisis or Consumption of the Lungs are the largest contributors to the stock of floating infection which exists in the environs of men. Physicians, bacteriologists, and pathologists, each reasoning on the line of the facts best known to them, concentrate upon this opinion. The hygienist sees no reason to dispute it. Nearly three-fourths of the deaths ascribed to tuberculosis are caused by Consumption.[1] Though the bacillus may reach the lungs by other paths than by the air, still the infection which establishes tuberculosis in the lungs and air passages is generally air-borne. Phthisis is the most frequent cause of Phthisis. It is a sufficient cause. Phthisical persons are to be found in every place and in every condition and position in which healthy persons are to be found. Everywhere, therefore, tubercle-bacilli may be distributed. For this reason, while all that has been said as to the discharge of bacilli in tuberculosis generally is correct, Phthisis has been regarded by all authorities who have taken special steps for the prevention of tuberculosis as either pre-eminently or alone among all its forms demanding precautionary measures. It is necessary, therefore, to enquire exactly how the bacillus is discharged and distributed from a case of Phthisis? in what sense Phthisis is and in what sense it is not infectious?—for a knowledge of the latter is of as much

[1] In Glasgow, 1890-94, exactly 73 per cent.

importance as of the former. If we understand how Phthisis becomes dangerous, we shall also understand the nature of the risks arising from tuberculosis generally.

The tubercle-bacillus is not "ubiquitous," *i.e.*, not everywhere present. Dr. Cornet has demonstrated experimentally that it haunts the vicinity of the consumptive. It is not in the expired air. It is not in the cutaneous exhalations. It abounds in the sputum. It abounds in the dust of the apartment. It is a well-known physical law that fluid or moist surfaces will not part with solid particles by evaporation or to a current of air. Hence the absence of bacilli in the expired air, and hence they are likewise imprisoned in the sputum. Even particles of sputum sprayed into the air by the violence of coughing, being gross, subside at once, and could only infect if coughed into the face of some one, and mixed with the actually in-going air. In order to be air-borne, the sputum must be dried and broken up into dust. If discharged into a handkerchief, it speedily dries, especially if it is put into the pocket or beneath the pillow. In the last stages of consumption the patient becomes weak, the sputum is expelled imperfectly, pillows, sheets, handkerchiefs are soiled. If an adult male, the beard or moustache is smeared. Even in the hands of the cleanly, without special precautions, such circumstances all tend to the production around the patient of a halo of infected dust maintained by every process of bedmaking, or of cleaning which includes the pernicious process happily described as "dusting." In the hands of the careless and the dirty, the infectivity is, of course, greatly aggravated. It attains its maximum of intensity where the filthy habit of spitting on the floor prevails, especially if it is carpeted.

The remedy is simply to spit into a spittoon containing a little water; and when a handkerchief must be used, to see that it never dries. Immerse it in water, and ultimately boil it. Better still, use a piece of cloth or paper, and burn it at once. Cornet found that where the spittoon was used,

and cleanly habits prevailed, there were no bacilli in the dust; where handkerchiefs were used, even though there was no spitting on the floor, there the dust was infective.

This is the golden rule in dealing not only with sputum but with *all* forms of tuberculous discharge, with the fæces when they are infected, the pus from tuberculous sores and abscesses, &c. *Keep them moist.* Especially do not allow any soiled linen or dressings to lie about and dry. Make it impossible for the discharges to pass into the condition of dust.

It is not merely the dried substance of the discharge which determines the bulk of the danger. All dust must be regarded as suspicious in the neighbourhood of consumptives. If there is any infection at all about, it is there. The ordinary constituents of dust—the fibres of linen and cotton, the shreds of wool—all act as rafts on which the infective germs are borne about, and with which they rise when disturbed.

The infected dust in apartments occupied or frequented without precautions by consumptives will subside indiscriminately upon any exposed surface, and may thus ultimately be swallowed, *e.g.*, upon plates, cups, glasses, basins, &c., viands of all kinds and fluids, such as milk or water. The latter are the most dangerous. They present more or less moist surfaces. No dust which falls on them can be blown away again, nor can they be cleaned.

The first person to suffer from carelessness with reference to sputum is the patient. He breathes an infected atmosphere, and in the struggle which is going on between his tissues and the bacillus, the latter is constantly reinforced, fresh territory is invaded, and the chance of recovery is destroyed. Auto-infection is one of the unavoidable risks of Phthisis. The chances of this occurring ought not to be knowingly increased. The use or misuse of handkerchiefs, and swallowing the sputum, are both likely occasions. These facts bring the precautions necessary in the public interest within the scope of the duties of the private physician in the treatment of a case of Phthisis.

Infection by Milk and Flesh.

The other sources from which man may derive the infecting bacillus are the milk and the flesh of diseased animals. That infection through the stomach is possible, we know from the observed effect upon consumptives of swallowing their sputum, and from experiments with animals. The process of cooking tends to diminish the risk; but in the case of milk there is no such safeguard interposed, owing to the habit of the country to consume it raw. The primary seat of tuberculosis in children is so frequently in the bowels and their related glands, and milk forms so large and essential an element in the food of children, that we cannot avoid the conclusion that it is to them a frequent source of infection. Indeed, there is a tendency to lose sight of infection by food, and especially milk, in the prominence given to infection through the lungs. In children especially even pulmonary Phthisis does not necessarily mean inhaled infection. In the recent report of the Royal Commission "On the Effect of Food derived from Tuberculous Animals on Human Health," we are told that, when the udder of the cow is infected, "the milk possesses a virulence which can only be described as extraordinary;" that "the spread of tubercle in the udder goes on with most alarming rapidity," so much so, that in the intervals of a fortnightly inspection it may develop; that when occasion has arisen to slaughter all the milch cows in town dairies, under the Contagious Diseases (Animals) Act, 40 per cent. have been found to be tuberculous, and that the statistics of slaughter-houses show that a very large percentage of all cows sent there are tuberculous. It is not surprising that the Commission reports—"No doubt the largest part of the tuberculosis which man obtains through his food is by means of milk containing tuberculous matter."

As to the conveyance of tuberculous disease through food, it is obvious that a very grave responsibility rests

upon local authorities to protect the consumer by a rigid and systematic inspection of butcher-meat, and by the elimination of every cow affected with tuberculosis in any degree from dairy-byres. As to precautions which are possible for the consumer to adopt, their nature is sufficiently indicated by paragraph 83 of the report of the Royal Commission already referred to, viz.:—

"Ordinary processes of cooking applied to meat which has got contaminated on its surface are probably sufficient to destroy the harmful quality. They would not avail to render wholesome any piece of meat that contained tuberculous matter in its deeper parts. In regard to milk, we are aware of the preference by English people for drinking cows' milk raw, a practice attended by danger, on account of possible contamination by pathogenic organisms. The boiling of milk, even for a moment, would probably be sufficient to remove the very dangerous quality of tuberculous milk."

The Conditions which Control Infection.

Although without the bacillus there can be no tuberculosis, we cannot call it the sole cause of the infection in the individual case. The theory of infection has a profound influence upon the practical aspects of prevention. The knowledge that infection passes with the body of a microbe, a minute living being, ushers us into the study of those complicated conditions which surround the maintenance and development of life.

We have already learned something of the restrictions imposed upon the tubercle-bacillus by some of those conditions. It can grow only within warm-blooded animals. It retains *vitality* with considerable tenacity outside the body, especially when dried, but sunlight, free air, and other natural agents, which first kill and then disintegrate, wage steady war against it. In the long run, therefore, only a fraction of the total quantity of infecting material survives until it has the opportunity to infect.

When at last the bacillus reaches its natural habitat, disease is not necessarily caused thereby. In other words,

but a small proportion of all who are exposed to infection, who actually inhale or swallow the bacillus, are infected. Every breath we inhale is loaded with particles of all kinds, organic and inorganic, dead or possessing the potency of life. A large proportion of this microscopic dust is caught in the nasal passages in the case of nose-breathers. Tubercle-bacilli have been found in the discharge from the noses of the attendants in wards occupied by consumptives. The moist lining of the air-passages catches the dust which passes the nose. The breath we exhale is optically pure. There are arrangements for expelling such particles—for scavenging the air-passages. If there were not, our windpipes would get choked as surely as unswept chimneys. What may be called local health is more important as a protection from the tubercle-bacillus than any other of the species of disease-germs, especially the integrity and vigour of the organs by which it enters the body. The bacillus is slow to develop, therefore there is a longer interval for its expulsion; but any catarrh, however local, anything which interposes a mechanical obstruction, or weakens the expelling power, or hampers the movements of the lungs, or provides crevices as resting-places, interferes with the expulsion of the bacillus, as of every other sort of foreign matter. In like manner, any impairment of the functions or integrity of the stomach or bowels favours infection; but inasmuch as the business of the stomach is to resolve and break up, and its acid juice is inimical, while in the bowels there are swarms of competing microbes, and the struggle for life is keen, the bacillus is more likely to perish in these regions. Still, anything of the nature of indigestion or local irritation may give the microbe a chance.

These are all obstacles to entrance within the substance of the tissues, for, as has already been said, the tubercle-bacillus is no more inside the body after it has passed the portal of the mouth than when it is floating in the dust of the air or in the milk of a tuberculous cow. It is nearer,

but *there has been no infection.* When it has effected a lodgment in the tissues, the production of disease depends upon the defeat of the antagonistic forces which surround it. These amount to nothing more than constitutional vigour—tissue-health. A condition of perfect health is one of insusceptibility. In this condition the juices of the tissues are poisonous to microbic life, and their cells active agents of destruction. Depression of vital resistance by disease, debauchery, fatigue, want, even by mental causes, induces susceptibility. Susceptibility may be constitutional, and may be so great and so marked as to amount to a predisposition. This it is which passes by inheritance, and, until the discovery of the bacillus, was regarded as hereditary tuberculosis. It is not the disease which is inherited. It is the pre-disposition—the feeble constitution, the low vitality, the *tout ensemble* of conditions, some of which are recondite and imperfectly understood, some obvious and capable of specification and comprehension. The outcome is a soil so congenial as to accept a delicate infection, from which the majority of mankind emerges absolutely scatheless; a soil which sustains and propagates the bacillus so vigorously that to popular observation the disease seems to be inherited. In such a person a blow or a sprain, a cold or sore throat, determines the local incidence. Nothing shows the reality of the antagonistic forces with which healthy animal tissues are endowed more strikingly than the numerous recoveries which take place, especially from pulmonary infection. In such cases there has been some temporary local susceptibility; but the vital forces have rallied, have invested the detachments of invaders, have cut of their convoys and scouts, and ultimately starved them out. The fact is undoubted. There is nothing in the world to accomplish this result but the native forces of the tissues. The phrase sounds rather mystical and metaphorical; but the forces are real, and may very confidently be trusted as most important allies in any general campaign against tuberculosis.

In such a contest as that which we have depicted, and alike in both stages, the number of bacilli engaged must obviously have an important relation to the result. It is impossible to express oneself without appealing to the analogies of warfare. In the stage of endeavour to obtain a footing, numbers must tell as effectively as in storming a breach; in the stage of maintaining a footing, as effectively as in the resistance of a garrison or the progress of an invasion. This introduces the all-important preventive doctrine of dilution. Infection is fifty times more likely to occur if there are fifty bacilli in each breath of air or pint of milk than if there is but one. Disease is ten times more likely to occur if the tissues are successfully invaded by ten bacilli at once than if by only one. Apart, therefore, altogether from the wholesomeness of ventilation and the vital energy imparted thereby, the merely mechanical effect of diluting or reducing the concentration of infective germs in air has an important protective and preventive power.

So much for infection in the light of the habits of the bacillus, but what we see is a diseased person—a case of consumption, for example. What has been the result of clinical observation as to the evidence of infection? Detached observations of what were regarded as actual instances of infection have been recorded, but their very paucity proves that, if there be infection, it must be effective under very special and extraordinary conditions. Yet it is astonishing how seldom one finds any satisfactory account of the conditions which predominate over all others —the hygienic. One records a case of marital infection, another a case of marital non-infection. We wish to know the conditions in both cases, *e.g.*, (1) whether the parties slept in the same bed, or in same room, or entirely apart; (2) whether they slept in a "box-bed;" what were the dimensions of the bedroom; (3) about its insolation and its ventilation. We may have a positive statement on the first point, but not always. As to the other and similar hygienic factors, rarely is a word said; and if there is, it is a mere general impression

or vague allusion. Perhaps the most systematic attempt ever made to collect clinical evidence of infection from Phthisis was that of the Collective Investigation Committee of the British Medical Association in 1883. Circulars were issued to the profession. Only 1,078 replies were received, and of these 673 contained a simple negative, and only 261 were affirmative. Unfortunately, the circular issued specifically asked for information about almost everything but the hygienic circumstances. The interest and importance of such an enquiry centre in the conditions surrounding both positive and negative observations. No one doubts that Consumption is communicable—or infectious, if you will—but it is obvious it can only be under very peculiar conditions. The very paucity and uncertainty of the replies to this appeal to the medical profession are an evidence of that. Still, a considerable number of the observers refer to ventilation, and we get such replies as the following:—A practitioner (166) who had noted five cases of apparent infection, adds, "In all the above cases the patients lived in small, confined houses, and slept in the 'box-beds' in use in Scotland. During 25 years I have not seen one case of contagion in the airy houses of the well-to-do." Another (168) records case of brother, sister, mother, father dying in this order, but he adds, "Family well-to-do, but they displayed great ignorance of ventilation. Children slept in an attic with an immovable skylight, and no fire-place or other means of ventilation. So morbid was the fear of draughts that the windows were hardly ever opened, and the atmosphere inside the whole house was most oppressive and stifling." We note such remarks as these in other cases—(169) "There was, no doubt, overcrowding in this house;" (172) "A. W. slept with his brother in a concealed bed in a badly-ventilated room for several months after his brother took ill;" (176) "in two other cases the houses were very badly ventilated;" (193) "living in same ill-ventilated room;" (194) "the house, consisting of two rooms and an attic, and lying under the brow of a hill on its northern aspect,

was ill-ventilated and worse lighted ;" (201) "her daughter, who slept in the same close, badly-ventilated room." An army surgeon gives the following sagacious answer :—(304) "I have no recollection of any particular case caught by contagion at present. Phthisical diseases have, during the course of my service as military surgeon, much diminished in barracks at home since increased cubic space, ventilation, and light were given to barrack rooms." In the great majority of the cases of apparent infection quoted, the parties were either husband and wife, or in relationship so far similar as to occupy the same bed or room. In the occurrence of consecutive illness, even in such highly-favourable circumstances, the determining influence of conditions is apparent. On the one hand, many practitioners state that they have never seen marital infection ; on the other, among the cases quoted by those who have, although, as we have already said, no special remarks had been asked on that head, we get such glimpses of the hygienic conditions as these—(6) "The bedroom was small, low, and miserable, about 12 ft. by 8 ;" (9) "their rooms were very close and warm ;" (33) "the room in which they lived was badly ventilated ;" (41) "it is only right to mention that the room in which the young couple lived was on the ground floor and damp ;" (43) "this is but one instance out of several in which I was much impressed with the apparent communicability of phthisis as from person to person. They were all cases among cottagers where the rooms were small, the ventilation bad, the food scanty, and the soil clay—conditions conducive to the development of phthisis under any circumstances ;" (53) "the house they lived in was very small, ill-ventilated, and in a close, poor neighbourhood ;" (54) "the wives were exposed to bad hygienic conditions, and took no due precautionary measures, seldom breathing pure air ;" (81) "slept in the same bed in a small, unventilated room ;" (100) "communicated from husband to wife —latter nursed former almost constantly in small, overheated, badly-ventilated room ;" (153) "I have for the last

20 years held that tubercular phthisis is infective as from husband to wife when sleeping together in ill-aired rooms." The conclusion of the Committee which reported upon the whole enquiry was this—

"One fact these returns seem to establish beyond any question, and that is, that if phthisis is a communicable disease, it is so only under circumstances and conditions of extremely close personal intimacy, such as persons sharing the same bed or the same room, or shut up together in numbers in close, ill-ventilated apartments."

Appended to Dr. Heron's book, "Evidences of the Communicability of Consumption" (1890), are references to 77 papers, &c., chiefly foreign, recording cases of apparent communication of tuberculosis, but the great majority are cases of accidental inoculation with tuberculous material—sputum, pus, crude tubercle, received by cuts or punctures in *post-mortem* dissections, in operations, &c. The interest of such events to local authorities is very slight. No one questions the existence of infectivity in such material, or the possibility of introducing it into the body by cuts or pricks, or by direct application to existing breaches in the skin. To the cases of apparent infection by the lungs, the same remarks apply as to the other series. They nearly all took place under the special condition of sleeping together, and nothing is ever said about the hygienic surroundings. Dr. Heron's summing up is this—

"The whole history of those cases which make up the evidence favouring the view that consumption is a communicable disease goes to show that the essence of the conditions under which infection, not due to inoculation, may take place, is close and prolonged association of a healthy person with a consumptive. There is also good cause for the belief that faulty ventilation is one of the most powerful helpers, if, indeed, it be not the chief helper, in spreading consumption among those who come into close and prolonged contact with tuberculosis" (p. 73).

Is Tuberculosis an "Infectious Disease"?—The answer is —Yes and No. It must be apparent from what precedes that, while in the *academic* sense tuberculosis is infectious, in the popular sense it is not. Even in the language of the schools, where words are weighed and meanings are qualified

to a nicety, hydrocephalus, although it is tuberculous, cannot in any sense be said to be infectious. Neither can many forms of tuberculosis of glands, bones, and joints. Until a discharge is established, they cannot be infectious. Indeed, it is doubtful if even those cases of miliary tuberculosis of the lungs which end in recovery ever are infectious, and it is certain that no case of Phthisis is infectious until the expectoration becomes specific. Tuberculosis, therefore, even in an academic sense, is a disease which, though in all cases caused by infection, is not in all cases infectious. There is no other infectious disease of which this can be said. The fact that it is not infectious in the popular sense is of much more importance for our present purpose. The popular idea of an infectious disease is one from which there is no safety save in keeping away from it. Proclaim a disease to be "infectious," and the people will pay no attention to qualifications. It is very natural—don't go near the person, and the conditions of safety need give no trouble! Education makes no difference. The fear of infection is indiscriminating even to absurdity. Enteric Fever, Scarlet Fever, Whooping-cough, Small-pox, all entail the same social ostracism. Belief in the protective influence of re-vaccination is found to be nothing more than a pious opinion when put to the test of personal conduct in reference to Small-pox.

There is a substantial excuse for the popular notion of an infectious disease in the fact that the law does not discriminate between one infectious disease and another. The words have a technical meaning, and every disease in the category is within the scope of every provision of the law applicable to infectious disease—compulsory isolation of the living and of the dead, compulsory disinfection, penalties for the use of public vehicles, for appearance in public places, whether streets or buildings, &c., &c. There is not a single power of interference with the liberty of persons suffering from Small-pox, the application of which to consumptives has not been advocated.

We may put aside the proposal to extend such demands to everything that can be designated "tuberculosis" as condemned in the utterance. Consider them as applied to Consumption alone. Recall all the representatives of that pale multitude one has known who bore the burden of their infirmity for years, few or many—not merely persons who died of consumption, but persons who were consumptives all their working lives—who did good work in the world, earned honest wages, supported themselves, supported others; all those one has heard of who lived more in the world's eye, who have instructed or entertained mankind, consumptives who have enriched our book-shelves, given us paintings for our walls, and satisfied our ears with music; all the phthisical patients to whom Sir Andrew Clark preached from his favourite text—"*Labor vitae vita est*—Work is the life of life," with himself as the example, born of parents who both died of phthisis, and sent to Madeira at 21 to die. Barely to declare that all such persons suffer from an "infectious disease" is clearly to take a grave responsiblity. They are infectious with a difference so vast as practically to separate them from all other infectious persons.

We have only to run over the various administrative procedures usually applied to infectious diseases to convince ourselves of this.

Compulsory Notification?—Although this has been frequently recommended in expert reports, and was voted by the Parisian Congress in 1888, and again in 1893, as necessary in reference to tuberculosis in general, the fact is chiefly noteworthy as a warning of the direction in which science, without practical discrimination, is moving. This would cover an enlarged cervical gland, a lupus, a white-swelling, a hydrocephalus, a "cold abscess," every form of local tubercle, as well as a case of Phthisis. The question has in reality, as a rule, resolved itself into a discussion of the propriety of requiring the notification of Consumption.

Even the Incorporated Society of Medical Officers of Health of England, when asked to resolve that "tuberculosis should be made a notifiable disease, notifiable under the same Acts, and under similar conditions to such diseases as Scarlet Fever," passed instead a resolution to the effect that they, "while accepting the view that Phthisis is an infective disease, in the prevention of which active hygienic measures should be taken, think it premature to recommend the compulsory notification of a *chronic disease like Phthisis*." The mere fact that Phthisis is a "chronic disease," so chronic, indeed, that it may extend, as we have seen, over years of active life, constituted a difficulty in the eyes of these practical men.

Isolation?—We must carefully distinguish between the humanitarian and the sanitarian aspect of this question. The conditions which determine infection from Phthisis are, as we have seen, very narrow. With proper precautions, they are obviated merely by sleeping alone. In Small-pox and in Typhus they are so wide as to include almost every case; in Scarlet Fever they are sufficiently wide to make removal to hospital advisable in three-fourths of the cases; and in Enteric Fever in about the same proportion. The essentially dangerous case of Phthisis is the one which is in the last stage, confined to the house or bed-ridden.

Disinfection?—The circumstances which require precautions in carrying out the washings of consumptive or other persons having tuberculous discharges are restricted very much in comparison with the ordinary infectious diseases. Indeed, the bedding and clothing are not necessarily infected. Nay, more, they seldom are infected. It is the helplessness or carelessnes of the patient which leads to infection of his garments, &c. Here again the advanced case, the fatal case, is the dangerous one; so that it would be well that washing and disinfection should, *always after death*, be undertaken by the authorities. If people possess the means of washing properly the clothing of the healthy

members of their household, they can also wash the ordinary linen of a consumptive. I see no reason for interference, even in the use of a common washing-house. If, however, people have not the requisite accommodation and appliances, if they are untidy and cannot be trusted to carry out any process of washing at all, then it might be carried out by the authorities, each case being considered in view of the circumstances. Whatever danger there is in any case emerges not from mere neighbourhood to or mere touching of articles, or from the act of washing, but from the disturbance of dust when they are dry. The moment they are wet the risk is gone.

The Advantages to the Consumptive of the New Doctrine.

It is characteristic of all official action in Germany (where the bacillus was discovered, and where the doctrine of tuberculosis was practically elaborated) in relation to the person of the consumptive to concentrate attention upon his expectoration. Every detail of injunction, as well as express statement, has the effect of liberating the consumptive from all social disability, so long as he is able to go about, *provided* he is careful to follow the simplest precautions as to expectoration; and when he is weak and bedridden, *provided* his attendants take up the *rôle* as to expectoration and are cleanly as to his other discharges. It is the same in France. Out of the periodic "Congress for the Study of Tuberculosis" sprang a "League for the Prevention of Pulmonary Phthisis and other forms of Tuberculosis," the primary object of which was to educate the people of France by the circulation of popular literature, each member acting as a distributing centre in his own locality. Their first issue was a code of instructions which has been scattered broadcast over France, in which this sentence is printed in emphatic type:—

"We know further that the consumptive is not in the least dangerous by contact or proximity, that it is neither his body nor his breath which is hurtful, and that we can chat with him for

hours, live with him for years, and even sleep in his room and give him the most constant care, without running any serious risk, *provided we take certain precautions*, the chief of which is to collect his expectoration, and not to delay the destruction of it until it becomes dry, and is disseminated as dust into the atmosphere."

This position is logical and unassailable. If you accept the doctrine as sound, the practice must be conceded as sufficient. Let there be spittoons handy for everybody; don't put your spit in the way of drying and becoming dust; don't anywhere stir up the dust in enclosed places. No doubt, the very simplicity of the prescription constitutes the greatest difficulty in the way of its acceptance and observance. To the vulgar a "spittle" is symbolic of all that is insignificant and contemptible. To base a cardinal matter of sanitary practice and regulation upon the how, and the when, and the where, people are to spit, requires some moral courage. Only a clear apprehension of, and firm belief in, the doctrine that practically Consumption is communicable through dried expectoration, and nothing else, will save the practice from ridicule.

How far it is to be explained by the fear of this—how far by the imposition of modern doctrines upon the top of the conception of a vague infection, instead of entirely substituting the one for the other—we cannot say; but the fact remains that in this country the advocates of the modern doctrines never seem to regard the consumptive with any more equanimity. They expound the *modus operandi* of infection; they prescribe spittoons and proscribe dust, just as is done on the Continent; but in place of manifesting confidence in the consumptive thus reformed in his habits, as they most expressly do abroad, the tendency here is to exhibit suspicion of him in all his ways. They would surround him with restrictions, and cover him with differential marks, which must make him almost as conspicuous in society as if he were clad in the grey gown and sounded the clapper of a mediæval leper—

> "They curse him in eating, they curse him in drinking,
> They curse him in coughing, in sneezing, in winking."

The jackdaw of Rheims was not "a penny the worse," but it would be far otherwise with the poor consumptive. Well may one say, "Show us your faith by your works;" but it is not the logical inconsistency, it is the cruelty, the inexpediency of these restrictions, which moves our criticism. They are cruel and inexpedient, because unnecessary. They deprive the consumptive of the very advantage of the modern doctrine to which Cornet never tires of adverting, "The consumptive in himself is almost absolutely harmless, and only becomes harmful through bad habits." In short, Cornet has proved by experimental induction, if ever any thing has been proved, that the sputum is practically the only source of infection in Phthisis; that where there is no sputum there is no infection; that the sputum is not infectious unless it dries; that it cannot dry excepting under certain conditions, perfectly easy to be avoided; that if these conditions are avoided, a consumptive is not a source of danger to anyone in the ordinary intercourse of society and the home.

GENERAL HYGIENE IN THE PREVENTION OF TUBERCULOSIS.

It is well known that long before bacilli were heard of, or any idea of attacking Phthisis on the lines of infection had been promulgated, it yielded extraordinary results to simple hygienic measures; results excelled in the case only of Cholera, Typhus, and Small-pox, even with the help of all the special methods applicable to those diseases, and not equalled in the case of any other infectious disease.

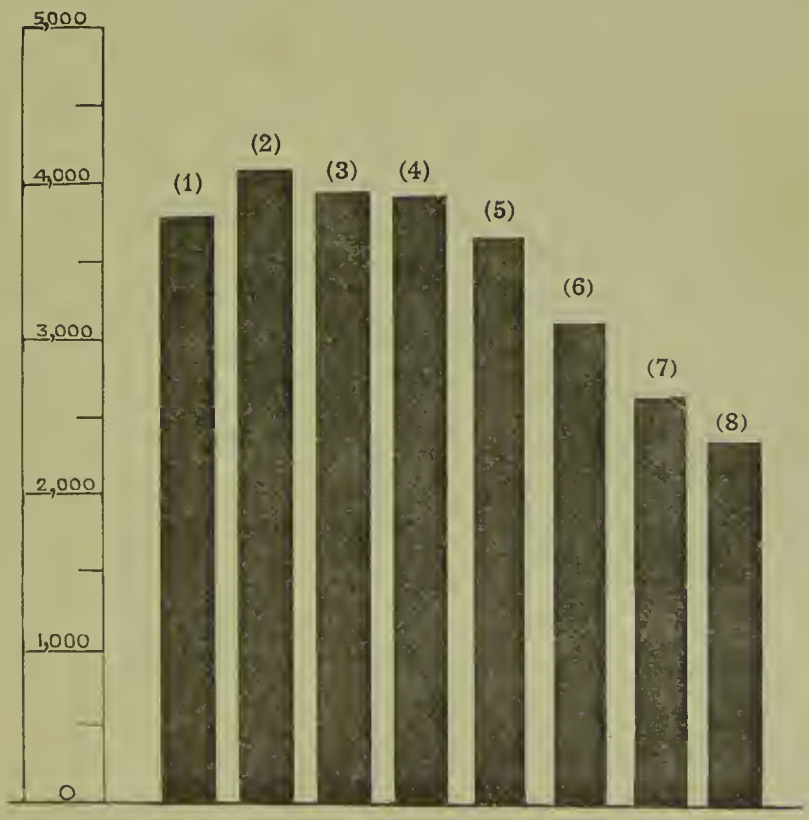
Statistics.

By giving our soldiers more cubic space and better ventilation, we have reduced the death-rate from Consumption 67 per cent. In 1865 Simon pointed out that sanitary works, more particularly the drying of the soil by the laying down of main sewers, had reduced the mortality from Phthisis in certain towns within periods of time rang-

ing from 3 to 11 years by from 11 to 49 per cent. This was the result of investigations carried out by Buchanan, the gist of which was formulated in the law that "dampness of soil is an important cause of Phthisis to the population living upon the soil." Dr. Janssens, who has made Brussels the centre of light and leading on the Continent as regards practical sanitation, states that in the three decennial periods —1864-73, 1874-83, and 1884-93—the death-rate from Consumption in Brussels was 46, 40, and 31 per 10,000. This represents a diminution of 33 per cent. in ten years from general hygienic measures alone.

Glasgow itself affords another equally remarkable illustration of the influence of general hygienic measures upon tuberculosis, as is shown in the following diagram :—

GLASGOW—DEATH-RATE PER MILLION FROM PHTHISIS IN QUINQUENNIAL PERIODS FOR 40 YEARS, 1855-94.



(1)—1855-59. (2)—1860-64. (3)—1865-69. (4)—1870-74. (5)—1875-79.
(6)—1880-84. (7)—1885-89. (8)—1890-94.

In the period 1860-64 Phthisis reached its highest mortality, 4,094 per million. In the period 1890-94 it was 2,315, so that in 25 years Consumption has been reduced 44 per cent. in fatality without special treatment as an infectious disease. If we turn to "Zymotics" for the same periods, we find that the combined effect of special efforts and general hygienic measures has been to reduce their fatality 50 per cent. Enteric Fever, which we are told tuberculosis most resembles as an infectious disease, was reduced 60 per cent. The proportion of the total deaths which took place in isolation rose from 7 per cent. to 66, which serves as an index of the extent to which every known special method was pushed. The reduction in Phthisis is very notable even by the side of these figures. Unfortunately, Phthisis is the only form of tuberculosis which has been throughout consistently classified by the Registrar-General as a cause of death. We can thus refer only to the 12 years, 1883-94, for evidence of the movement of tuberculous diseases other than Phthisis. Dividing them into two periods of 6 years, we find that the death-rate from "Phthisis" has fallen from 2,849 per million to 2,316, and from "Other Tubercular Diseases" from 1,090 per million to 884, in both cases 19 per cent. Clearly, then, we are warranted in asserting that among infectious diseases tuberculosis is the most amenable of all to general hygienic measures; that, in fact, from these alone as good results are obtained as from hygienic measures plus isolation, disinfection, &c., in the case of diseases popularly known as infectious. It is not implied that special measures directed against the infectivity might not have produced even better results; but in view of what has been accomplished, and in view of the difficulties in the way of special precautions, it is contended that more is to be expected from general hygiene.

APPLICATION OF THE DOCTRINE OF TUBERCULOSIS.

We have already gone with some detail into the relation of local and general health to tuberculosis through their influence on the bacillus. Everything within the control of the individual which promotes and maintains soundness of body; everything within the control of the municipality or the State which improves the physical conditions beyond which the individual living in populous communities cannot go, which raises and maintains the standard of public health, comes within the scope of the prevention of tuberculosis. So that, to treat this aspect of prevention in its fulness, would be to write a treatise on private regimen and State medicine. Nevertheless, there are some of the elements of health which tuberculosis marks with special importance.

A copious supply of pure air and distribution of direct and diffused sunlight within and without the dwelling are not only wholesome to man, but are directly fatal to the bacilli distributed outside the animal body. Sunlight is the only disinfectant which sustains the man while it kills the microbe. Therefore, whatever withdraws from the air we breathe impurity of smoke, or dust, or foul exhalation, and from the sky above us that canopy of smoke which reduces our sunshine to twilight; everything which promotes free motion of air without and within the house; every bye-law which regulates the width of streets, the height of houses, the arrangement of buildings, so as to offer no obstruction to the winds, and to secure as much light and as little shadow in the hours of daylight as possible, which promotes the access of the sun's rays to dwellings, and helps to make the sky visible from the floor of all inhabited rooms, which widens and brightens lobbies and staircases in tenements, which prevents dampness of foundations and walls; every regulation which checks overcrowding both in house and workplace, which protects the artificer from irritating dust and fumes and secures to workers of every

degree and kind natural light and pure air in the place of their employment ;—all are precautions against tuberculosis.

The lungs are like every other organ, their health is promoted by free and full use. Deep inhalation of pure air—especially the open air, the air which is moving freely in the great currents we call winds, which is clarified by sunshine—gives vigour to the lungs, and supplies the heart with well oxygenated blood to be sent throughout the body, increasing the insusceptibility of every tissue. Therefore, every public park, and the flowers and music which attract people thither, every open space and children's playground, every cricket and football field, every gymnasium and drill-ground, is a precaution against Consumption.

It is remarkable with what unanimity those who have studied Consumption clinically testify that no diseases predispose to it more frequently than Enteric Fever, Scarlet Fever, Measles, and Whooping-cough. Enteric Fever produces a profound and long-continued depression of the vitality, which favours a lodgment of the bacillus. If, perchance, tuberculous milk should be given to such patients, who are practically sustained for weeks on milk and nothing else, it certainly would infect. Scarlet Fever, in its severer forms, also reduces constitutional resistance. On the other hand, Measles and Whooping-cough create for the bacillus an opportunity chiefly by their influence on local health, producing debility in the lungs, to which Whooping-cough frequently adds great general exhaustion. It follows from these facts that all hygienic measures which tend to prevent Enteric Fever, and whatever is done to limit the spread and prevent the complications of the infectious diseases of children, are precautions against Consumption.

In combating tuberculosis in the lower animals, hygienic measures bear an equally important part. Indeed, the tuberculosis of animals is begotten of the domestication of animals by man, and the perversity of man in treating them as if fresh air and sunlight were less essential to their

health than to his own. The fact is they are more essential. Tuberculosis prevails among the different species in proportion to the extent to which man has, for his purposes, made them denizens of closed spaces; and most of all in the cow, which he has entirely taken possession of, and which he treats as if foul air and darkness were conditions of its being. Dogs and cats also share in the risks of the society of consumptives who are careless in their habits. The improvement of the hygiene of the domestic animals is a precaution against Consumption in man.

The direct and indirect practical issues of the doctrine of tuberculosis are very various, and can only be effectively worked out through the intelligence of the community. They touch the business of administrative bodies of every kind, not merely municipal, but parochial, charitable, corrective, educational, and others both of a public and private character. They affect the personal habits of a considerable proportion of the citizens, and the duties of those about them, and, in certain circumstances, responsible for them. They concern the health of all.

It is scarcely necessary to point out that many departments of municipal management ought to be inspired with renewed energy, and to receive increased precision of direction, each in its own special work, from this doctrine of tuberculosis, *e.g.*—

The Committee on Health, in the application of general and local powers to the suppression of damp, dark dwelling-houses; to the dissemination of light and air within and around tenements and workplaces, whether factories, workshops, warehouses, counting-houses, or offices; in the enforcement of ventilation, light, and cleanliness in byres; in the provision of open spaces and play places convenient to tenements; in the elimination of tuberculous cows from the sources of milk supply; and of tuberculous meat from the meat supply; in stimulating the various municipal departments to act their several parts in the crusade.

The Magistrates Committee, in the suppression of smoke, and the energetic application of the law in all cases relating to overcrowding, cleanliness of the house, and other matters of domestic police, which, if not associated in the judicial mind with some large principle, are apt to sink to the rank of petty details, rather vexatious than otherwise.

The Parks and Galleries Committee, in the support they derive for the conviction that their parks are only useful in proportion as they are used, and that therefore they must be made attractive, and that the same attractions will not draw every class in the community. Flowers are wanted for some, music for others, but always space for the young—the play-place for the children, and the cricket and foot-ball field for the lads. The youthful instinct to play and sport is accessory to growth and development, and this Committee may, by providing suitable space for the gratification of that instinct, powerfully aid in building up strong resistant constitutions in the youth of Glasgow.

The Committee on Sewage Works will see more clearly a hygienic sanction for their function in the prospect of sweetening the air, and transforming the Clyde from an offensive, repulsive sewer into an attractive water-way, on which he that fares will find wholesome food for his lungs, and which will be a temptation to one of the most useful recreations for developing their capacity, and thus raising the vital standard of the whole body.

The Committee on Tramways may find moral courage to enforce their bye-laws against spitting "in or upon any car," which, in fact, means to compel the male sex to refrain, for hygienic reasons, from doing that which the female sex, from a sense of propriety, never does.

The Dean of Guild Court will recognise the profound importance of its functions in the rigid enforcement of every item of the provisions of the law which virtually determine

the health of the future in so far as it depends upon a dry foundation and walls, and upon the distribution of light and the free movement of the air in and around the dwelling, and not only there, but wherever human beings are employed in earning their bread.

The practical issues of this doctrine of tuberculosis, as regards the individual and the family, in matters which can only be touched by private effort, actuated by the growth of intelligence, are many and various, and must be trusted to the evolution of thought in the process of time. How to deal with *domestic dust* is, perhaps, the most important of these issues. It is to be desired that women should understand the importance of dust in the causation of Consumption, and should devise methods of dealing with dust which will end in its collection and destruction, not merely in its disturbance and redistribution. Tuberculosis confers hitherto unimagined dignity on tea-leaves! Not merely as housewives, but as sick nurses, women ought to study these modern doctrines.

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